

EFFECTS OF HYPERGRAVITY EXPOSURE ON PLASMA OXYTOCIN CONCENTRATIONS IN PREGNANT AND LACTATING RAT DAMS

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ABSTRACT

Rat dams and offspring were exposed to 1.5-g, 1.75-g or 2.0-g hypergravity (*hg*) from Gestational day [G] 11 until Postnatal day [P] 10. To ascertain the role of maternal factors in reduced postnatal body weights of offspring developed in *hg*, the dams' lactational hormones were measured. Oxytocin (OT), the major hormone responsible for milk ejection, was reduced in *hg* dams whereas prolactin (Prl), involved in milk production, was unchanged. Video analyses of nursing behavior revealed that *hg* dams spent more time nursing relative to 1-g controls. We hypothesized impaired milk transfer from dam to pup, however pup body weight gains following a discrete suckling episode were comparable across conditions. Changes in lactational hormones and nursing behavior by dams exposed to *hg* do not account for reduced body masses of their offspring.

1. INTRODUCTION

Infant mammals subsist entirely on mother's milk. The transfer of milk from mother to young is a complex process governed by multiple bi-directional signals and regulations. Successful nourishment of young mammals is dependent upon: 1) maternal nutritional status, 2) lactation-related hormones, 3) nursing and other infant-directed responses by the mother, and 4) the ability of the infant to suckle from the teat. The anterior pituitary hormone, prolactin (Prl), is responsible for milk production. To provide adequate sustenance to her rapidly growing litter, the lactating rat must produce 10-15% of her body weight in milk each day. Milk is then released or 'let-down' by the mother approximately 80 to 100 times per day at intervals averaging 6 min (1). The ejection of milk from the teat is dependent upon the anterior pituitary hormone, oxytocin (OT). Suckling stimulation by the pup provides the stimulus for OT release and milk letdowns (1).

Young rats developed at *hg* are smaller and weigh less than those reared at 1-g (2-4). This is also true of adult rats (e.g., 5). We previously reported that rat dams exposed to 1.5-g hypergravity from mid-pregnancy throughout lactation have 5-15% less body mass than 1.0-g controls. The dams exhibit negative energy balance during the first three days of *hg* exposure, but quickly adapt to the increased gravity environment as evidenced by a return to energy balance within six days of *hg* exposure (6). These findings suggest that the nutritional status of lactating dams does not account for reduced body masses of *hg* pups.

In the studies presented herein, we tested the hypothesis that reduced body masses of *hg* pups are associated with decreases in maternal hormones responsible for lactation (Expt. 1); with insufficient nursing behavior by the dams (Expt. 2), or due to inadequate milk ejection and transfer (Expt. 3). Pregnant and lactating rat dams were exposed to either 1.5-g, 1.75-g or 2.0-g from G11 until P10, a time of abundant milk production in the rat.

2. GENERAL METHODS

Timebred female Sprague-Dawley rats were used. A more comprehensive description of the methods can be found in ref. 5. Briefly, dams were individually housed under standard vivarium conditions. On G9, dams were weight-matched then assigned to one of the following conditions: 1.0-g, 1.5-g, 1.75-g, or 2.0-g. On G11, continuous centrifugation (19.98 RPM) was initiated. For each measure, data were combined across *hg* conditions since no differences were observed. Litter averages were used for analyzing data. Data were analyzed using ANOVA and Student's t-test.

3. GROWTH AND DEVELOPMENT OF RAT PUPS REARED IN HYPERGRAVITY

Consonant with previous reports (2-5), *hg* pups weighed 8-15% less than 1.0-g controls (Fig. 1). Higher g-loads were associated with smaller body mass.

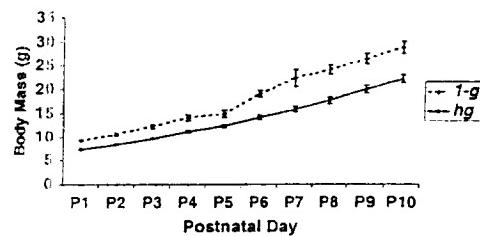


Fig. 1. Daily postnatal body mass gain of hypergravity (*hg*)-exposed rat pups compared to 1-g controls. Hypergravity exposure spanned Gestational day (G) 11 to Postnatal day (P) 10. (N=6 litters /condition.)

4. EXPT. 1. EFFECTS OF HYPERGRAVITY ON PRL AND OT IN PREGNANT AND LACTATING RAT DAMS

On P10, blood samples were obtained from lactating rat dams and compared to those taken from G20 pregnant dams from the same study. Plasma Prl and OT were analyzed in duplicate by radioimmunoassay (RIA).

Table 1. Plasma prolactin (Prl) and oxytocin (OT) concentrations in rat dams across gravity conditions (1.0-g, 1.5-g, 1.75-g, or 2.0-g).

	Concentration (ng/ml)*		
	<i>hg</i>	1.0-g	Significance
<i>Prl</i>			
G20	8.65 (2.15)	6.79 (2.18)	ns
P10	47.82(9.47)	50.32 (7.31)	ns
<i>OT</i>			
G20	0.26 (0.07)	0.18 (0.03)	ns
P10	0.76 (0.11)	0.93 (0.09)	p < 0.05

* mean +/- sd